

REPLACEMENT CLAIMS

Cancel claims 11 and 20.

- A'
1. (Amended) A method for forming a semiconductor device comprising:
providing a semiconductor substrate;
forming a metal oxide layer over the semiconductor substrate;
forming a patterned gate electrode over a first portion of the metal oxide layer; and
removing a second portion of the metal oxide layer by heating the semiconductor substrate
and flowing a halide-containing species over the substrate while heating, wherein the
second portion of the metal oxide layer is adjacent to the first portion of the metal
oxide layer;
wherein removing a second portion of the metal oxide layer is performed in a reaction
chamber in the absence of rf activation.
 2. (Amended) The method of claim 1, wherein the halide-containing species further comprises
hydrogen.
 3. (Amended) The method of claim 2, wherein the halide-containing species is HCl.
 4. The method of claim 1, wherein the metal oxide layer is hafnium oxide.
 5. (Amended) The method of claim 1, further comprising:
forming an patterned ARC layer over the patterned gate electrode prior to the flowing of
the halide-containing species; and
removing the patterned ARC layer after the flowing of the halide-containing species.
 6. (Amended) The method of claim 5, further comprising:
forming a first interfacial oxide layer under the metal oxide layer;
removing at least a portion of the first interfacial oxide after removing the second portion
of the metal oxide layer.

7. (Amended) The method of claim 6, wherein removing at least a portion of the first interfacial oxide layer is performed using a species containing hydrogen and fluorine.

8. The method of claim 7, further comprising forming a second interfacial oxide over the semiconductor substrate.

A¹
com.

9. The method of claim 1, wherein the step of removing is further characterized as being at a temperature of between about 625 degrees Celsius to 675 degrees Celsius.

10. (Amended) The method of claim 9, wherein the step of removing is further characterized as being at a pressure of about 50 torr for approximately 60 seconds and a flow rate of the halide-containing species at about one SLM.

11 ~~12~~. The method of claim 1, wherein heating is performed using a radiation source.

12 ~~13~~. (Amended) A method of removing a metal oxide layer that is over a semiconductor substrate, comprising:

placing the semiconductor substrate into a reaction chamber;

heating the metal oxide layer;

flowing, in the absence of rf activation, a chlorine-containing species while heating,

wherein the chlorine-containing species reacts with a portion of the metal oxide layer

to create a byproduct, wherein the byproduct comprises an element from the metal

oxide layer; and

removing the byproduct from the reaction chamber.

A²

13 ~~14~~. (Amended) A method for forming a semiconductor device comprising:

providing a semiconductor substrate;

forming a metal oxide layer over the semiconductor substrate comprising hafnium and oxygen;

removing a portion of the metal oxide layer by heating the semiconductor substrate using radiation and flowing a species containing hydrogen and chlorine;

wherein removing a second portion of the metal oxide layer is performed in a reaction chamber in the absence of RF activation.

¹³
14¹⁵. The method of claim ¹³14, wherein heating the semiconductor substrate is at a temperature between about 625 degrees Celsius to 675 degrees Celsius.

¹³
15¹⁶. The method of claim ¹³14, wherein the semiconductor substrate comprises silicon.

A2
Cont. ¹⁵
16¹⁷. The method of claim ¹⁵16, further comprising:
forming a first interfacial oxide layer under the metal oxide layer;
removing at least a portion of the first interfacial oxide after removing the portion of the metal oxide layer;

¹⁶
17¹⁸. (Amended) The method of claim ¹⁶17, wherein removing at least a portion of the first interfacial oxide layer is performed using a species containing hydrogen and fluorine.

¹⁷
18¹⁹. The method of claim ¹⁷18, further comprising forming a second interfacial oxide over the semiconductor substrate.

A3
19²¹. (Amended) A method of forming a metal oxide comprising:
providing a semiconductor substrate;
forming a metal oxide layer over the semiconductor substrate; and
removing a portion of the metal oxide layer by heating the semiconductor substrate and
flowing a gaseous halide;
wherein removing a portion of the metal oxide layer is performed in a reaction chamber in the absence of RF activation.

¹⁹
20²². The method of claim ¹⁹21, wherein the gaseous halide comprises hydrogen.

²⁰
21²³. The method of claim ²⁰22, wherein the gaseous halide is HCl.

²⁰
22²⁴. The method of claim ²⁰22, wherein the gaseous halide is HF.

¹⁹
23²⁵. The method of claim ¹⁹21, wherein the metal oxide contains hafnium and oxygen.

¹⁹
24~~26~~. The method of claim ~~21~~¹⁹, wherein heating the semiconductor substrate is at a temperature between about 625 degrees Celsius to 675 degrees Celsius.

25~~27~~. A method of selectively removing a metal oxide layer from a semiconductor substrate, wherein the metal oxide layer has an exposed portion and a portion under a gate electrode comprising the step of flowing gaseous HCl, in the absence of rf activation, over the substrate with the substrate heated to between 600 and 800 degrees Celsius.

A3
Cont. 26~~28~~. The method of claim ~~27~~²⁸, wherein the substrate is heated to between 625 and 675 degrees Celsius.

27~~29~~. The method of claim ~~28~~²⁶, wherein the metal oxide is hafnium oxide.

28~~30~~. The method of claim ~~29~~²⁷, wherein the substrate is heated by radiation.

29~~31~~. The method of claim ~~30~~²⁸, wherein the metal oxide overlies an oxide layer.
